SWORN TRANSLATION

I, Kosaku SUGIMURA, hereby declare and state that I am knowledgeable of each of the Japanese and English languages and that I made the attached translation of the attached application from the Japanese language into the English language and that I believe my attached translation to be accurate, true and correct to the best of my knowledge and ability.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued therefrom.

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Declarant : Kosaku Sugimura

Kosaku SUGIMURA

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[Title of the Invention]	METHOD FOR MANUFACTURING A PNEUMATIC TIRE
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[Inventor]	
[Address]	c/o BRIDGESTONE CORPORATION Technical Center, 3-1-1, Ogawahigashi-cho, Kodaira City, Tokyo, Japan
[Name]	Shuhei IIZUKA
[Applicant]	
[Identification Number]	000005278
[Name]	BRIDGESTONE CORPORATION
[Representative]	
[Identification Number]	100072051
[Patent Attorney]	
[Name]	Kosaku SUGIMURA
[Representative]	
[Identification Number]	100059258
[Patent Attorney]	
[Name]	Akihide SUGIMURA
[Identification of Fee]	
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[Name of Document] SPECIFICATION

[Title of the Invention] METHOD FOR MANUFACTURING A PNEUMATIC TIRE

[Claims]

[Claim 1] A method for manufacturing a pneumatic tire comprising forming, prior to molding a green tire, at least one kind of tire constitutive member on the outer circular surface of a carcass band, under a state where the cylindrically shaped carcass band has its central portion located between two bead portions expanded outward in the radial direction, by applying a non-vulcanized rubber strip on the outer circular surface of the expanded carcass band by spirally turning round the strip thereupon.

[Claim 2] A method for manufacturing a pneumatic tire as described in claim 2 wherein the cross-section of the strip is determined depending on the shape of a tire constitutive member the strip is made into, and the strip is spirally turned round such that, for each turn, a previously turned strip is superimposed at least partially by a successively turned strip, so as to allow the resulting lamination to form the constitutive member.

[Claim 3] A method for manufacturing a pneumatic tire as described in claim 1 or 2 wherein two or more kinds of non-vulcanized rubber strips are spirally turned round one after another, to form a tire constitutive member.

[Claim 4] A method for manufacturing a pneumatic tire as described in any one of claims 1 - 3 wherein the tire constitutive member includes a bead filler, a side-wall, a rubber chafer, a buffer rubber and a belt underlying cushion.

[Claim 5] A method for manufacturing a pneumatic tire comprising forming, prior to molding a green tire, at least one kind of tire constitutive member on the outer circular surface of a carcass band, under a state where the cylindrically shaped carcass band has its central portion located between two bead portions expanded outward in the radial direction, by applying one or more kinds of non-vulcanized

rubber strips onto the outer circular surface of the expanded carcass band by spirally turning round the strip thereupon.

[Claim 6] A method for manufacturing a pneumatic tire as described in claim 5 wherein the cross-section of the strip is determined depending on the shape of a tire constitutive member the strip is made into, and the strip is spirally turned round such that, for each turn, a previously turned strip is superimposed at least partially by a successively turned strip, so as to allow the resulting lamination to form the constitutive member.

[Claim 7] A method for manufacturing a pneumatic tire as described in claim 5 or 6 wherein the tire constitutive member includes a tread, a cushion between adjacent belt layers, and a tread underlying cushion.

[Claim 8] A method for manufacturing a pneumatic tire comprising combining a manufacturing method as described in any one of claims 1 to 4, and another manufacturing method as described in any one of claims 5 to 7 as appropriate in an appropriate order according to a given requirement.

[Detailed Description of the Invention]

[0001]

[Technical field of the Invention]

The present invention relates to a method for manufacturing a pneumatic tire, particularly a radial tire whereby it is possible not only to satisfy the requirements imposed on the various constitutive elements of a tire with regard to their shape and material, but also to enable the highly precise molding thereof.

[0002]

[Description of the Related Art]

A conventional, widely adopted method for manufacturing a pneumatic tire comprises, prior to the molding of a green tire, winding various tire constitutive members made of rubber materials and pre-molded in the foregoing step, around a molding drum one over another in an orderly fashion for adhesive joining; and deforming those tire constitutive members in various manners.

[0003]

[Problems to be Solved by the Invention]

With the increased high performance of a tire in recent years, the requirement for tire constitutive members becomes so stern that the shape of the members becomes complicated. If such tire constitutive members are wound around a tire molding drum according to a conventional method, the precision with regard to the winding position will degrade, or irregularities will develop at the joints between different constitutive members wound around the tire molding drum, because there occurs a big difference in circumference between inner members and outer members both of which have a complicated form, and thus the uniformity and balance of the tire product will be impaired.

[0004]

On the other hand, there is not infrequently a case where the tire constitutive members cannot be integrally formed into a unit to give a desired shape owing to, for example, the requirement imposed by the equipment of the preceding step responsible for the pre-molding of those tire constitutive members. In such a case, the constitutive members are divided into a plurality of sub-units; the sub-units are separately pre-molded; and the yields are assembled to give a tire with a desired shape. However, according to this method, the number of necessary units increases which in turn causes the number of steps introduced for winding constitutive members around a molding drum and the number of joints observed on the molding drum to increase. This not only lowers the efficiency in the molding of a green tire but also degrades the uniformity and balance of the tire.

Moreover, if a tire constitutive member has a laminated rubber structure composed of different rubber layers, the tire constitutive member pre-molded may have the risk of becoming unstable in its shape because of qualitative differences among those rubber layers.

[0005]

This invention aims at solving the above problems encountered with the conventional technique, and its object is to

provide a method for manufacturing a pneumatic tire whereby it is possible to securely form tire constitutive elements which are pre-molded in a desired shape, into a desired shape at any given time, even when they are made of a plurality of rubber materials different in property, without causing the number of necessary units to increase; to wind the tire constitutive members around a molding drum without exposing them to the risk of being degraded in positioning precision due to the winding itself; to improve the efficiency of the work necessary involved in tire molding, as well as the uniformity and balance of tire product; and further to prevent the tire from being exposed to the risk of being degraded in performance due to the existence of irregular joints between the tire constitutive members.

[0006]

[Means for Solving the Problems]

The method of this invention for manufacturing a pneumatic tire comprises, prior to the molding of a green tire, under a circumstance where the central portion of a cylindrical carcass band flanked by two bead portions are deformed by being expanded outward in the radial direction, applying a non-vulcanized rubber strip on the outer circular portion of the expanded carcass band, by spirally turning round the strip on that portion, thereby forming at least a constitutive member such as a bead filler, side-wall, rubber chafer, buffering rubber or belt underlying cushion.

In this case, it is also possible to spirally turn round two or more kinds of non-vulcanized rubber strips in succession to form a tire constitutive member.

[0007]

According to this method, a non-vulcanized rubber strip 5 - 20mm in width and 0.2 - 3mm in thickness is spirally turned round on the outer circular surface of a carcass band deformed in advance by expansion into a shape similar to that of a green tire, being driven by an extrusion machine, injection/extrusion machine or constant volume extrusion machine, being laid one turn over another to form a lamination

for serving as a necessary constitutive tire member. Therefore, even if the tire constitutive member is designed to have a complicated shape, it is possible to produce the member simply, easily and precisely without being restricted by the requirement imposed by the molding equipment.
[0008]

Further, because the method comprises directly turning round a strip spirally on the outer circular surface of tire, it allows the constitutive member to be positioned far more precisely than with the method wherein the previously molded constitutive member is applied by adhesion on the outer circular surface of tire, and irregularities at joints to be more effectively eliminated. As a consequence, this method greatly improves the efficiency of the work involved in tire molding, as well as the uniformity and balance of the tire product.
[0009]

In addition, according to this method, because a strip is directly turned round spirally on the outer circular surface of tire to form a tire constitutive member thereupon, it is possible to thoroughly eliminate the instability in form of the constitutive member, even if the constitutive member is made of different rubber materials, because then the method consists of turning round strips of different materials one after another in succession.
[0010]

In this method, it is preferred to vary the cross-sectional shape of a strip in accordance with the desired shape of the tire constitutive member the strip is made into, and to turn round the strip such that, for each turn, a preceding turn is superimposed at least partially by a succeeding turn.

Through this procedure, it is possible to further improve the precision in positioning of the tire constitutive member, and the uniformity thereof.
[0011]

The above features also holds for a method comprising, prior to the molding of a green tire, under a circumstance where the central

portion of a cylindrical carcass band flanked by two bead portions are deformed by being expanded outward in the radial direction, applying a belt layer on the outer circular surface of the expanded carcass band, and then applying one or more kinds of non-vulcanized rubber strips on the outer circular surface of the belt layer by spirally turning round the strips thereupon, thereby forming at least a constitutive member such as a tread, inter-belt cushion or tread underlying cushion.

[0012]

Combining the former method whereby a strip is turned round on the outer circular surface of an expanded carcass band with the latter method whereby plural strips are turned round on the outer circular surface of a belt attached to an expanded carcass band will further improve the uniformity and balance of the tire.

[0013]

[Embodiments of the Invention]

Preferred embodiments of this invention will be described below with reference to accompanying drawings.

Firstly, a carcass ply consisting of ply cords is applied to a carcass band drum in such a way as to cause the cords to extend in the circumferential direction of the drum, in order to modify the carcass ply into a cylindrical shape, thereby producing a carcass band; then, for example, bead cores are attached to both marginal portions of this carcass band, and the marginal portions of carcass band are folded back around bead fillers and the bead cores.

[0014]

Then, with regard to the carcass band configured as above, while it is applied to the carcass band drum or to other molding means such as a formalizing means, both bead rocks 1 are diverged from each other to elongate the radius as shown in FIG. 1 to be stabilized there; a pressurized gas is fed directly, or indirectly via a bladder, into the space surrounded by the inner face of carcass band 3, thereby causing the central portion of carcass band 3 to expand outward in the radial direction under a circumstance where both bead rocks, or more

accurately both bead cores 2 are being converged towards each other; in the above state, a non-vulcanized rubber strip 4 whose material and dimension are appropriately chosen and which is extruded, for example, from a nozzle of an extrusion machine, is applied on the outer circular surface of carcass band by being spirally turned round once or plural times thereupon in such a way as to cause a preceding turn to be superimposed at least partially by a succeeding turn within a desired range along a circular direction; and thereby a tire constitutive member generally having a desired shape and dimension is obtained.

[0015]

FIG. 1(a) shows a case where a rubber chafer 6 and a side-wall 7 are obtained by this method, that is, by turning round respective strips such that one turn is superimposed by another to form a lamination, excepting a bead filler which is positioned adjacent to the outer peripheral surface of bead core 2. FIG. 1(b) shows a case where the side-wall 7 is obtained by turning round a strip while the rubber chafer 6a is obtained by a conventional method which consists of applying a band by adhesion.

[0016]

After necessary tire constitutive members are formed as above, for example, increasing the degree of deformation by expansion of the carcass band 3, and bringing the crown portion thereof into intimate contact with a belt tread band 8 (to be referred to as a "BT band" hereinafter) which has been pre-molded to give a definitive dimension in its external and internal diameters, results in the formation of a completed green tire.

[0017]

FIG. 2 shows a method whereby the central portion of carcass band 3 is intensively deformed by expansion to such an extent that the central portion comes in intimate contact with a BT band 8, before application of rubber chafer 6 and side-wall 7 to the carcass band is achieved by turning round respective non-vulcanized rubber strips 4 thereupon. According to this method, the rubber chafer 6 and

side-wall 7 are relieved of deformations associated with expansion which would otherwise result if they were applied and then the expansion of the carcass band introduced. This will contribute to improve their shape and positioning precision.

[0018]

FIG. 3 shows an illustrative example where formation of a bead filler or a tire constitutive member is achieved by spirally turning round a non-vulcanized rubber strip on the carcass band. FIG. 3(a) shows a case where formation of a bead filler 9 is achieved by turning round a non-vulcanized rubber strip 4 on the outer circular portion close to a bead core 2, before the marginal portion 3a of carcass band 3 is folded back around the bead core 2.

In this case, the entire bead filler 9 may be made of one kind of rubber, or it may be made of two kinds of rubbers different, for example, in hardness or post-vulcanization properties.

[0019]

FIGS. 3(b) and 3(c) show a case where, of a bead filler 9, a portion 9a located at a distal position and another portion 9b located at a proximal position in the radial direction are separately obtained by turning round respective non-vulcanized rubber strips 4 while the remaining portions 9c and 9d are formed in advance by molding rubber materials the same or different with or from the above rubber materials into a desired shape.

[0020]

According to any one of the above methods, if the marginal portion 3a of carcass band 3 is folded back around bead core 2, the bead filler 9 will be wrapped up together with bead core 2 into the marginal portion 3a.

The subsequent molding works may proceed according to the methods as discussed above with respect to FIG 1 or 2, or to the methods described later.

[0021]

FIG. 4 shows a case where a bead filler 5, rubber chafer 6a

and side-wall 10 all pre-molded are applied around a carcass band 3 by turning round those members thereupon to adhere thereto using a conventional technique; after the central portion of carcass band 3 is deformed by expansion until it is brought into intimate contact with the inner circular face of a belt layer ring 11 properly set in advance, a non-vulcanized rubber strip 4 consisting of one or two kinds of rubber materials are applied to the outer circular face of the belt layer ring 11 by spirally turning round the rubber strip thereupon; and thus a tread 12 having a cap-base structure with conductive layers penetrating the cap and base in the radial direction is formed on the central portion of carcass band 3.

[0022]

In this case, together with the formation of tread 12, formation of a mini-side wall 13 ,which will bridge tread 12 and side-wall 10 may be introduced by spirally turning round a strip on the relevant area. Or, only tread 12 may be formed. In the latter case, a pre-molded mini-side wall may be added after the tread 12 is formed.

[0023]

FIG. 5 shows a still further embodiment where the central portion of a carcass band 3 is intensively deformed by expansion so as to be brought into intimate contact with a belt layer ring 11 while its folded-back marginal portion 3a contains a bead core 2 and bead filler 5 in its folded-back portion; a belt 12 is formed by the method described above with respect to FIG. 4; then a side-wall 7 and a rubber chafer 6 are formed by the method described above with respect to FIG. 1(a).

In this embodiment, it is also possible to form side-wall 7 and rubber chafer 6 before the formation of tread 12.

[0024]

The preferred embodiments of this invention have been described with reference to the accompanying figures. However, needless to say, this invention also applies to the manufacture of a so-called bead core-less tire. Further, the tire constitutive member may include a buffer rubber to be applied on the carcass ply, and a belt

underlying cushion to be inserted between the belt layer and the carcass band, and further a tread underlying cushion to be inserted between the tread and the belt.

[0025]

[Advantage]

As discussed above, according to this invention, it is possible to securely confer tire constitutive members with their respective desired shapes at all times, even if they are made of different kinds of rubber materials, by applying non-vulcanized rubber strips having a desired dimension and made of materials satisfying given requirements, by spirally turning round them on a carcass band, without requiring an increased number of necessary parts therefor, and without exposing the members to the risk of becoming unstable in their shape. It is also possible to prevent the lowering of positioning precision caused by the turning round of the tire constitutive element itself; to greatly improve the uniformity and balance of tire product, thereby raising the efficiency of the molding work; and to satisfactorily prevent the occurrence of impaired uniformity or balance which may arise as a result of irregularities at the joints between different constitutive members.

[Brief Description of the Drawings]

[FIG. 1] This is a cross-sectional view normal to an axial direction of a half of an embodiment of this invention.

[FIG. 2] This is a cross-sectional view normal to an axial direction of a half of another embodiment of this invention.

[FIG. 3] This is a cross-sectional view normal to an axial direction of a half of a still further embodiment of this invention.

[FIG. 4] This is a cross-sectional view normal to an axial direction of a half of a still further embodiment of this invention.

[FIG. 5] This is a cross-sectional view normal to an axial direction of a half of a still further embodiment of this invention.

[Reference Numerals]

1: Bead rock

2: Bead core

3: Carcass band

3a: Marginal portion

4: Non-vulcanized rubber strip

5, 9 Bead filler

6, 6a Rubber chafer

7, 10: Side-wall

8: BT band

9a, 9b: Portions

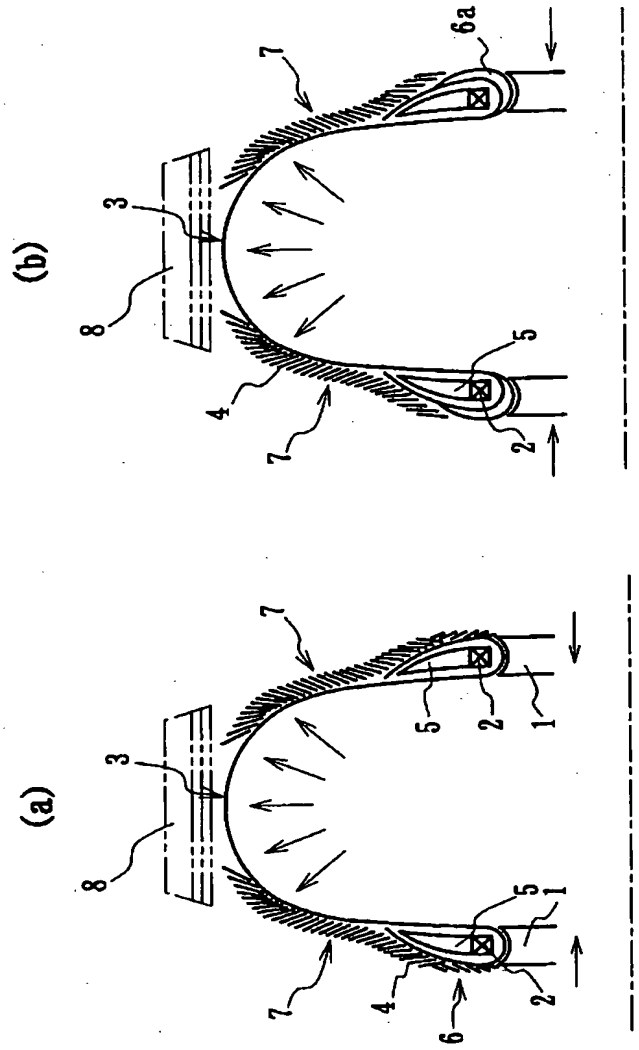
9c, 9d: Remaining portions

11: Belt layer

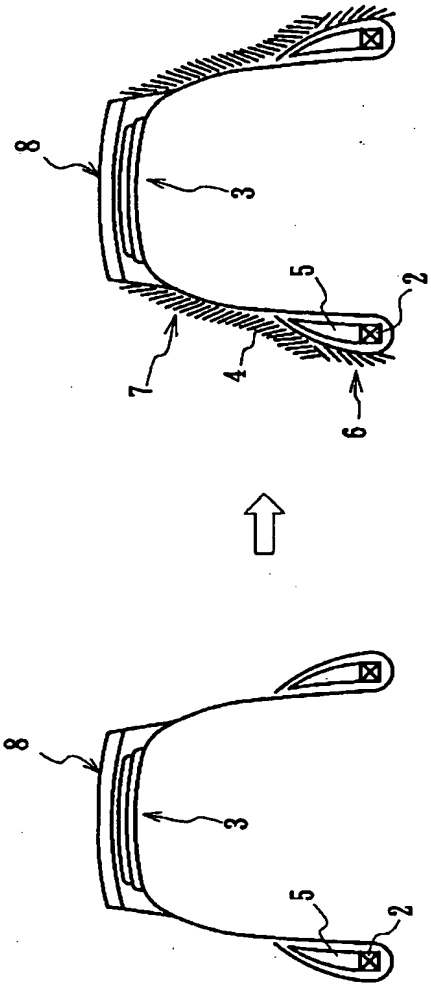
12: Tread

13: Mini side-wall

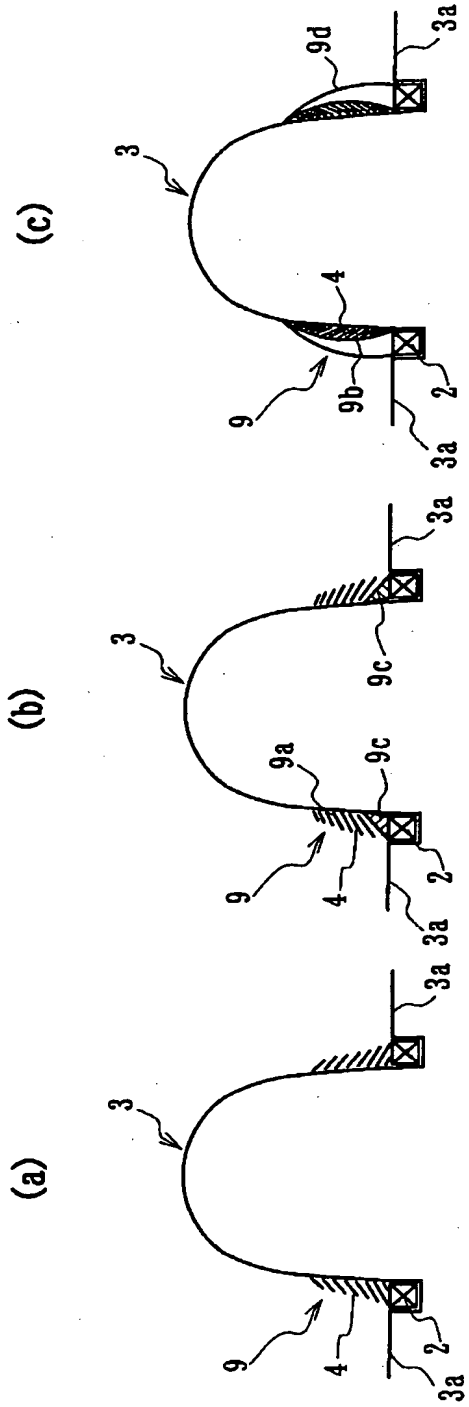
【書類名】　　図面
[Name of Document]　Drawing
【図１】
[Fig. 1]



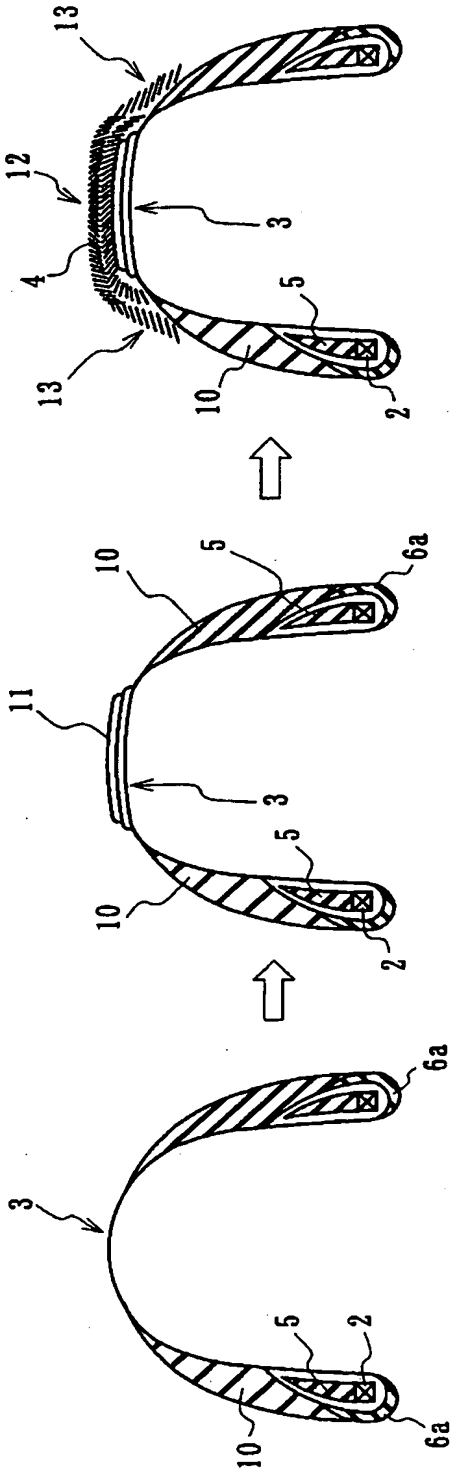
【図２】
[Fig. 2]



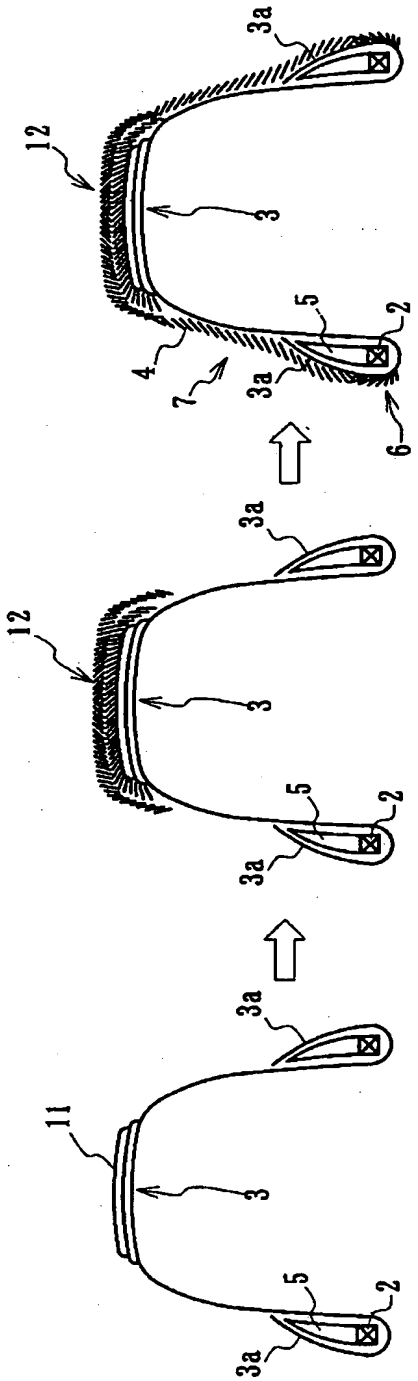
【図３】
[Fig. 3]



【図４】
[Fig. 4]



【図５】
[Fig. 5]



[Name of Document] ABSTRACT

[Abstract]

[Object] To provide a method whereby it is possible to securely confer tire constitutive members with their respective desired shapes, without requiring an increased number of necessary parts therefor; to improve the uniformity and balance of tire product as well as the efficiency of the tire molding work; and to prevent the occurrence of impaired uniformity or balance which may arise as a result of irregularities at the joints between different constitutive members.

[Solving Means] The object is achieved by providing a method wherein a non-vulcanized rubber strip 4 is applied, prior to the molding of a green tire, on the outer circular portion of an expanded carcass band 3 under a circumstance where the central portion of the cylindrically shaped carcass band 3 flanked by bead cores 2 are deformed by expansion outward in the radial direction, by spirally turning round the strip 4 on that portion to thereby form a side-wall 7.

[Selected Drawing] FIG. 1